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Mainline Explicit Fencing

A new era for graphics

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Open First

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Agenda

- Introduction
- Android Sync Framework
- Mainline Explicit Fencing
- Current Status

Fencing

- Ensure ordering between operations
- Synchronize buffer sharing
  - e.g.: Between GPU and Display drivers
- Allow async operations
- Implicit fencing: userspace not aware
- Explicit fencing: userspace aware

Implicit Fencing

- No userspace knowledge/interference
- Simple/Dumb compositors
  - No buffer state information
- But it can freeze the whole desktop!

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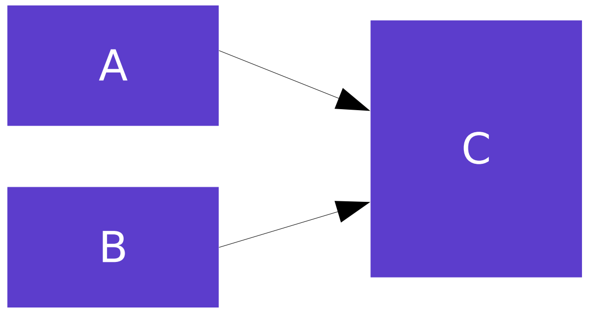
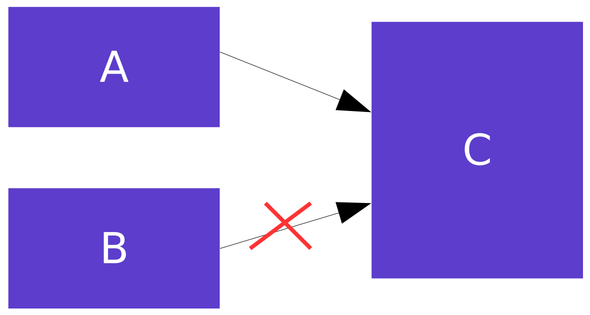
Implicit Fencing



- Buffer C will be composed of A and B
- Buffers A and B can render in Parallel
- Compositor notified only when both finishes

Implicit Fencing



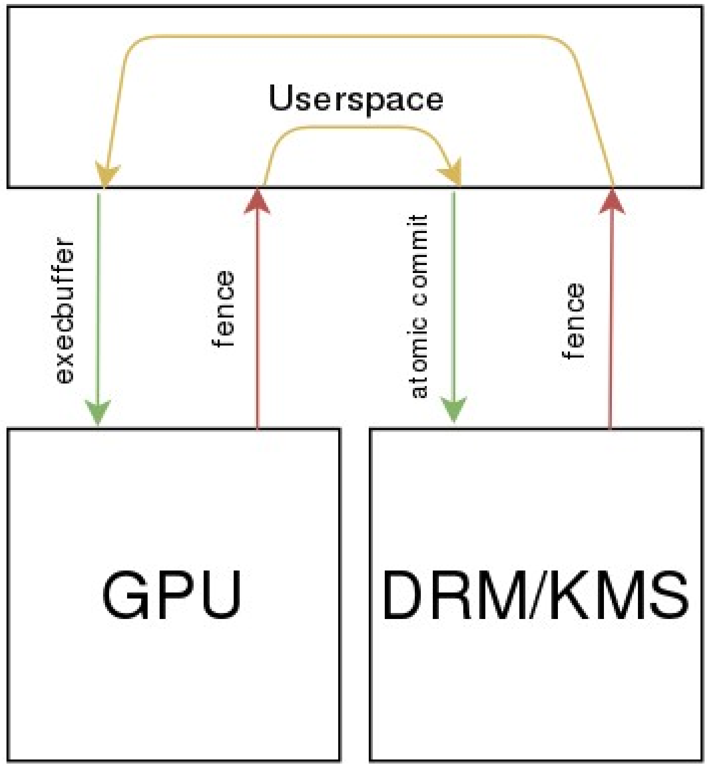
- A is fast and B takes too long
- C is blocked waiting for both to render
- The entire desktop freezes!

Explicit Fencing

- Fences goes to userspace
- Userspace can control synchronization
- Smart decisions on compositors
- Avoid blocking the entire desktop

Explicit Fencing

- Consumer/Producer without blocking



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Explicit Fencing

- Better for traceability/debuggability
- Vulkan needs it
  - Part of the API
  - Efficient subbuffer processing

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Android Sync Framework

- Android's Explicit Fencing implementation
- Use fd for fence passing
- **Sync Timeline** to control ordering
- **Sync Point** to represent a fence
- **Sync Fence** for fd passing

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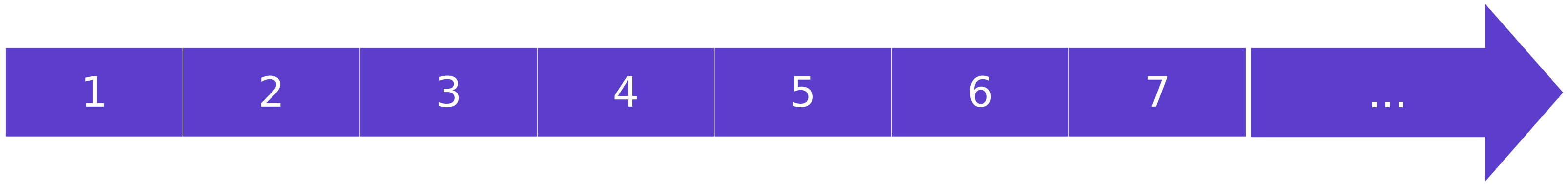
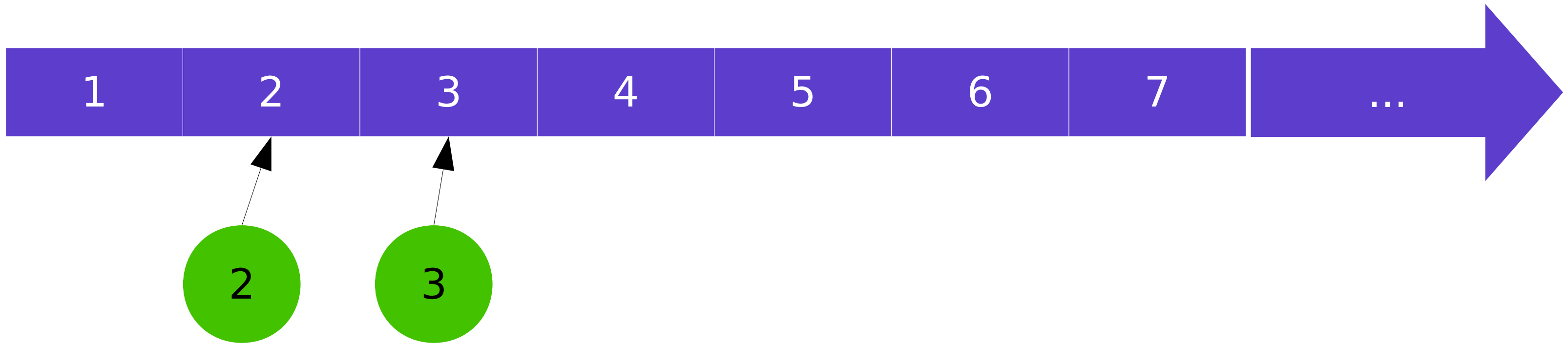
Sync Timeline



- Monotonically increasing counter
- Usually one timeline per driver context

Sync Point



- It is the fence
- Represents a value on the timeline
- Three states: active, signaled and error

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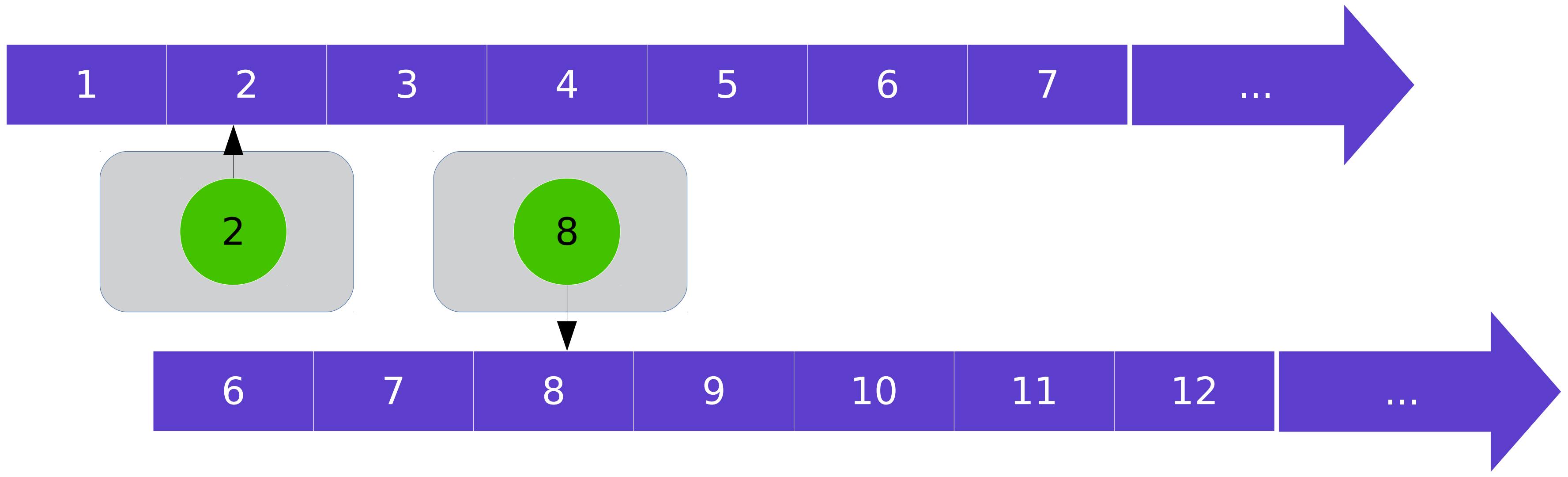
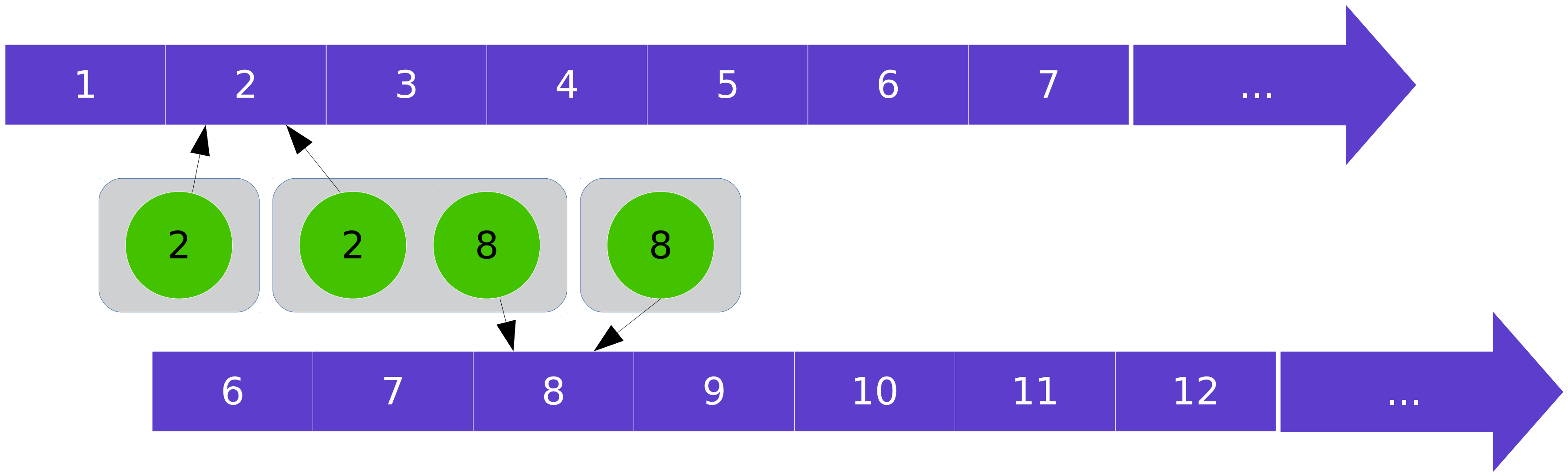
Sync Fence



- Wrap Sync Point into a file
- Also have active and signaled states
- Shared via fd-passing to/from userspace

Sync Fence



- Sync fences can be merged!
- It can contain many Sync Points

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Android Sync Framework - ioctls

- sync_wait(fd, timeout)
- fd3 = sync_merge(fd1, fd2)
- sync_fence_info(fd, info)

Mainline Explicit Fencing

- Started with the fence synchronization mechanism by Maarten Lankhorst
- Buffer synchronization between drivers

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struct fence

- fence->context
- fence_signal()
- fence_wait()
- fence_add_callback()

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Sync Framework de-staging

- Android Sync added to staging in 2013
- Mainly need for fd-passing
- Removed Sync Timeline
- Removed Sync Point
- Reworked Sync Fence

Sync File

- Renamed Sync Fence to Sync File
- Changed ioctl API
  - Provided patch to Android's libsync
- Removed internal kernel API
- Used strictly for fd-passing
  - sync_file = sync_file_create(fence)
  - fence = sync_file_get_fence(fd)

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struct fence_array

- Subclass of struct fence
- Store multiple fences
- Useful for merged Sync File
- Hide complexity from the drivers
- fence_is_array(fence)

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DRM/KMS

- Only available for Atomic Modesetting
- Entirely in DRM Core
- Extended Atomic IOCTL
- in-fences: received from userspace
- out-fences: sent to userspace

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DRM/KMS: in-fences

- in-fences: fences received from userspace
- FENCE_FD property on each DRM Plane
- Receives sync_file fds carrying fences
- drm_atomic_helper_wait_for_fences() helper

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DRM/KMS: out-fences

- One out-fence per DRM CRTC
- get_unused_fd() + sync_file_create() + fd_install()
- It signals at CRTC scanout
  - It means the **previous** buffer can be reused.
- Userspace need to ask for out-fence
  - DRM_MODE_ATOMIC_OUT_FENCE flag
  - libdrm: drmModeAtomicAddOutFences()

DRM/renderer

- Similar to KMS side
- Extends execbuffer ioctl args on each driver
- Every driver needs sync_file/fences support
- WIP on freedreno, i915 and virgl

Mesa

- EGL_ANDROID_native_fence_sync
  - Create fence fd
- EGL_ANDROID_wait_sync
  - Make the GPU wait for fence to signal
- WIP by Rob Clark
- kmscube running on explicit fencing

drm_hwcomposer2

- Already support DRM fences semantic
- Use it as example userspace for upstream
- WIP by Sean Paul and Robert Foss

Current Status Summary

- Sync File syncronization de-stage: DONE
- SW_SYNC validation de-stage: DONE
- fence_array: DONE
- DRM/KMS: WIP – 4.10?
- DRM/renderer: WIP – 4.10?
- MESA: WIP
- igt-gpu-tools: WIP
- drm_hwcomposer2: WIP
- Wayland: TODO
- V4L explicit fences: TODO

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Thank you!

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